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NON-RADIAL PULSATIONS OF ζ Oph

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Fast line profile variations in the spectra of Be stars are now attributed to non-radial pulsations of these stars, assiciated with the equivalent width variations. Strictly speaking this is true only for the periodic variations. There are transient ones as well. Whether this mechanism produces the disk around a Be star, is still the subject of debate. Spectra of the HeI λ 6678 line of the Be star zeta Oph (O9V) show distortions which propagate uniformly across the absorption line profile. Vogt and Penrod (1983) concluded from their observations, that the line profile distortions are caused by high-order non-radial pulsation and an l=8, m=8 mode provides a good fit to many of the line profiles. The observed amplitude of the pulsation correlates apparently with episodes of emission outburst of ζ Oph from season to season.

The author's first measurements with the LHIRES III slit-grating spectrograph (0.11 Å/pix, spectral resolution R = 14000) in Fig. 1. were made during 1.5 hours (JD 2456061.418-2456061.492) with the 40-cm SC telescope of the Vereinigung der Sternfreunde Köln (Germany). The individual spectra were taken with 15 minute exposure time in a cadence of 30 minutes. A comparison with Vogt & Penrod-spectra taken on 29 June 1980 and 1 July 1980 (see Fig. 1 in Vogt & Penrod, 1983) shows a high similarity, and encouraged further observations.

HeI λ6678 equivalent width measurements of the author's 2012/05/16 observation (Fig. 2) are compared with the August 1981 series of Vogt and Penrod's spectra in Fig. 3 [planimetering by P. Harmanec of the line-profile plots in Vogt and Penrod's paper (Harmanec, 1989, table 4)]. Harmanec (1989, p. 231) concludes that "no clear correlation of the equivalent width changes with the 0.643 day period is apparent". Contrary to that conclusion, the observations presented here show a very clear increase with time during JD 2456064.371 to JD 2456064.598.

Follow-up observation runs during 2012/05/24-27 were dedicated to figure out whether the equivalent width is suitable for determination of the period behaviour (Figs. 4 and 5).

The HeI λ6678 absorption line profiles of these observations in Fig. 4 are strongly shaped by the appearance and disappearance of an absorption bump at 6575-6580 Å, which usually moves uniformly across the line. This bump often shows a noticeable asymmetry in the way in which it traverses the profile.

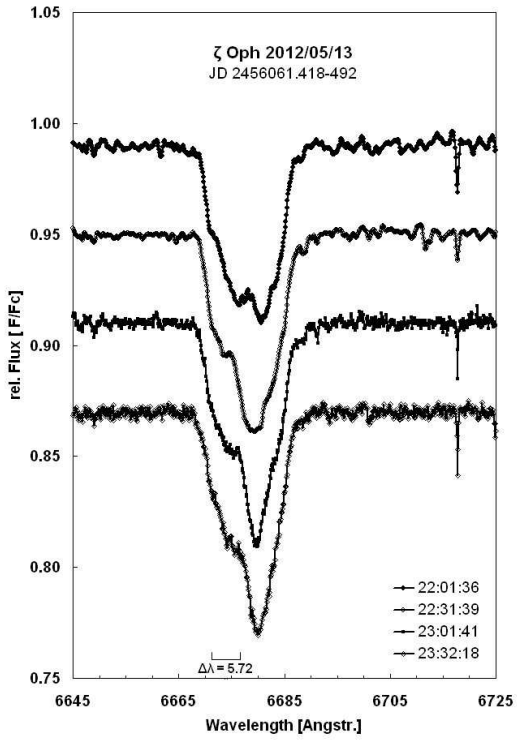

Figure 1. The first 40-cm SC telescope measurements (JD 2456061.418-2456061.492)

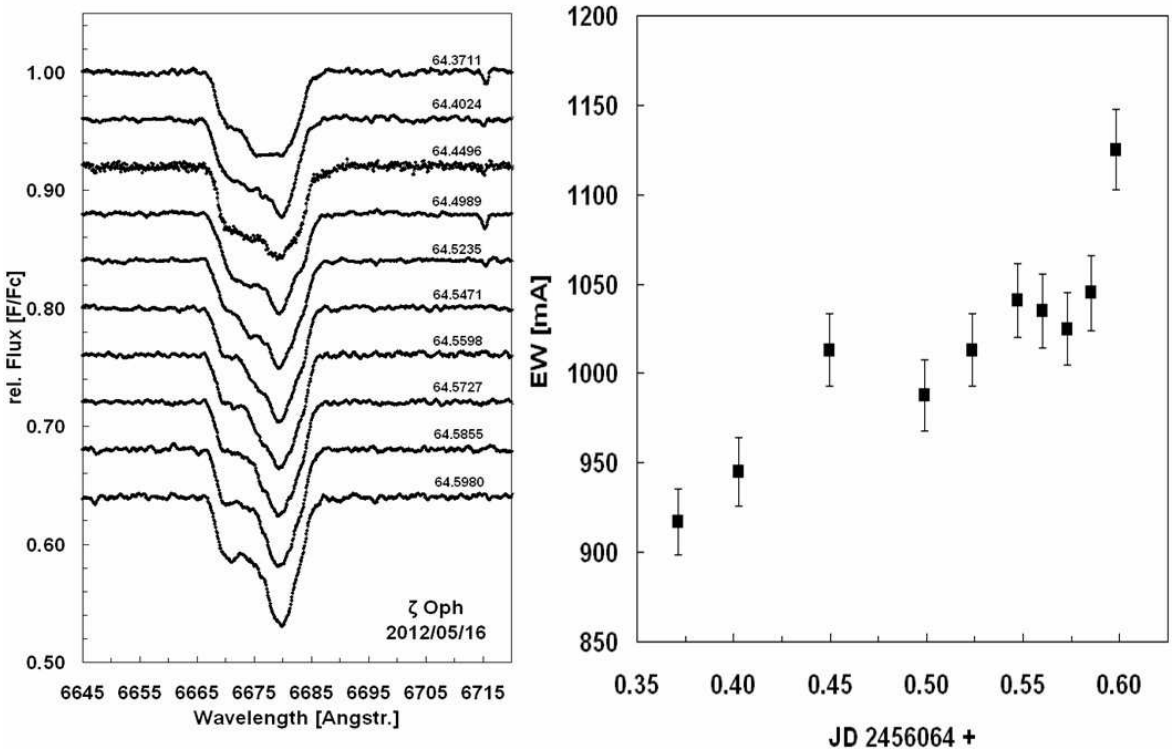

Figure 2. Observations of 2012/05/16; individual spectra (left), equivalent width vs. time (right)

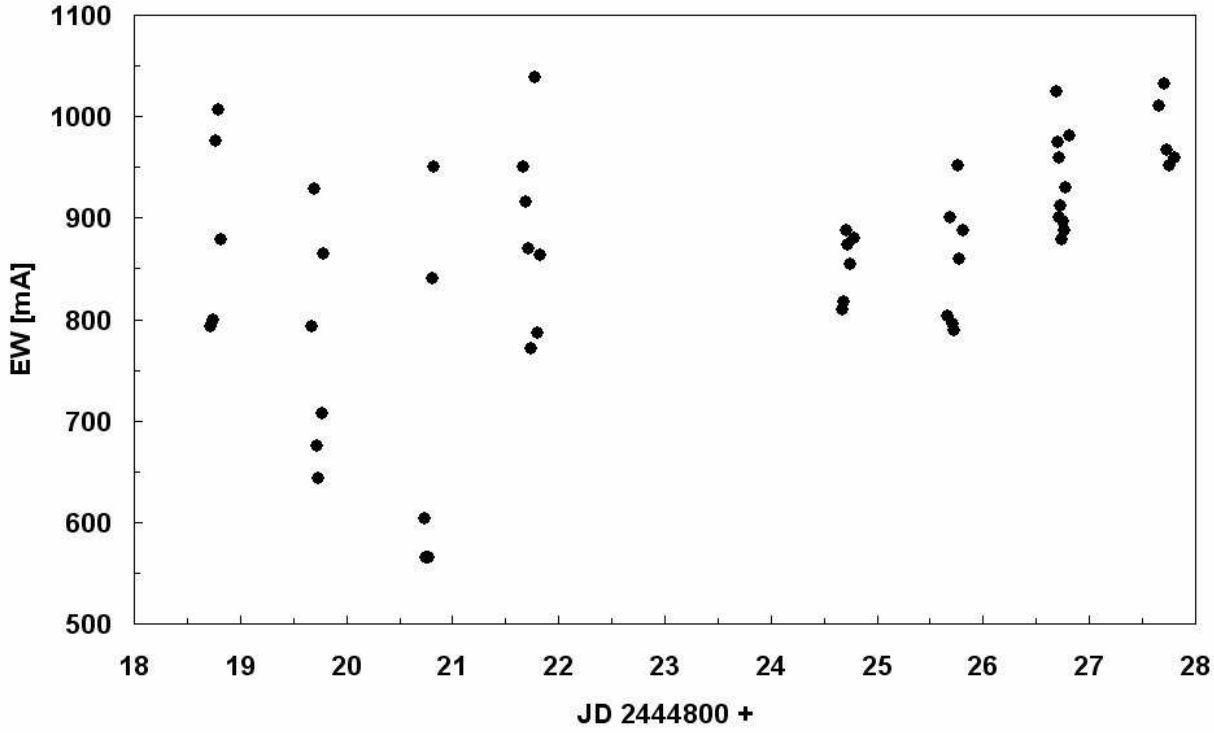

Figure 3. Planimetric measurements of HeI λ 6678 equivalent width (no error bars were indicated) in August 1981 spectra of Vogt & Penrod

Fig. 5 shows the period and phase analysis of the 2012/05/24-27 observations. The upper plot shows the time behaviour of the HeI λ6678 equivalent width, the middle plot shows the dominant period at 0.643 d and the lower plot shows the phase representation of this period. I used the AVE program (http://www.astrogea.org/soft/ave/aveint.htm) to search for periodicities and found a period of 0.643 days, whereas Harmanec (1989) found no variation in EW in August 1981 spectra of Vogt & Penrod.

The importance of these observations should be seen in the context of the many publications in the past, particularly the highly precise MOST (Microvariability and Oscillations of Stars) photometric and ground-based spectroscopic data of Walker et al. (2005). They conclude that the 0.643 d period might be the signature of very fast equatorial rotation.

Acknowledgements:
I am grateful to Prof. Dr. Gordon A. H. Walker (referee of this observation report) for his positive evaluation and encouragement, to continue my observations during coming visibility periods of the star.

References:

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Vogt, S. S. & Penrod G. D., 1983, *ApJ*, **275**, 661
Walker, G. A. H. et al., 2005, *ApJ*, **623**, L145

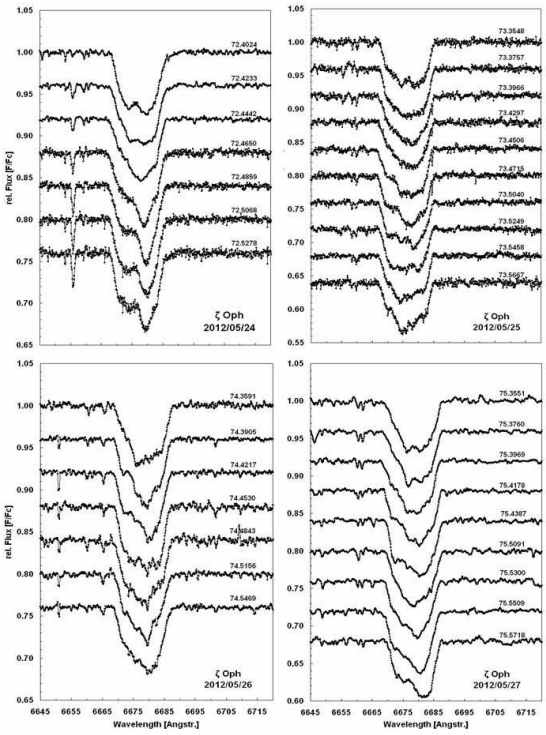

Figure 4. Individual spectra of the 2012/05/24-27 observations

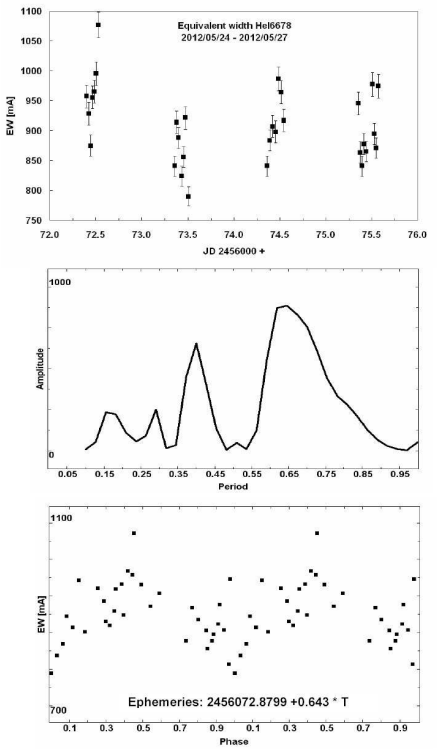

Figure 5. Equivalent width versus time (top), periodogram (middle), phase curve (below)